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Risk Attitudes and Choice under Uncertainty

Experimental Evidence from Russia

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CONTENTS

I. INTRODUCTION

Transition of the former communist countries to the market economy is undoubtedly one of the key phenomena of the last decade of twentieth century. Among these countries, Russia obviously occupies an outstanding position. Russian economy is the largest of these, so the perspectives of reforms in this country are of global significance. But Russia also had the longest experience of planned economy, which reasonably allows to expect the transitional process to be most complicated here. Indeed, a three-generation life experience of the communist economy resulted in an establishment of the most rigid and strong authoritarian system of economic institutions and organizations. The mere system failed, but such an experience apparently hurts the process of transition to the modern free market economy, for it had influenced not only the habits and style of economic activities, but also the perception of economic reality by Russians agents. The last conjecture is reinforced by the fact that the collapse of the communist system was very fast and sharp in comparison to the previous period, so that many people may felt lost in an environment completely unknown to them.

Yet another reason for possible troubles on the way of the efficient market system formation resides in the features that are typically ascribed to the Russian mentality. A «mysterious Russian soul» is often expected to manifest itself in a fairly unpredictable way, which led some people to argue that the market system is not convenient for Russia. An adjacent traditionalist argument states that the population of Russia, being located in-between the East and the West, is naturally endowed with exceptionally particular spirit and mentality, which, at the extreme, is to invalidate the patterns of individual behaviour commonly observed and recognised as cornerstones of modern market economies.

Are these expectations well-grounded? The present paper provides some evidence which suggests that the answer to that question is no, to some extent at least. Our experimental work is focused on rather narrow topic - individual attitudes toward risk; but its results show that little if any serious difference exists between Russian subjects and the rest of the world in that particular respect. Of course, this conclusion is limited not only to the field of comparison, but also to the subject sample. To enhance calibration of results we draw our conclusions on the basis of samples similar to those involved in analogous experiments in both Western and Eastern countries,- namely, to undergraduate students in economics. On the other hand, as long as our evidence concerns only risk attitudes, it is difficult to extend the claim «we all are similar» to Russians in a large variety of institutional settings. Some insights into these later are provided in the second part of our paper, dedicated to public choice experiments.

In this latter case some differences reported below may at best require cultural explanations, whereas the risky choice evidence might address a number of questions important for economic theory. In particular, experiments may be insightful to seek for an explanations of some «nonconventional» phenomena met in economies in transition (as well as in developed market economies). We believe that a thorough investigation of real-life transitional phenomena has to go beyond the regular study of macroeconomic indicators and forecasts on plausible consequences of particular economic policies. Not less, if not more important key to the understanding of many transitional phenomena resides in the patterns of individual behaviour, which were heavily influenced by drastic institutional changes. A number of features peculiar of transitional epoch (e.g. inefficient restructuring and management in many industrial enterprises, propagation of financial pyramids, uncommon patterns of adjustments in the labour market) hardly can be understood without a careful look at economic motivation on the micro level. Traditional methods of applied economic analysis (collecting statistical data, building and testing particular models) do not appear to be quite appropriate for a study of real people's subjective motivation. It seems that experimental methods are more convenient to fill this gap.

The paper is organised as follows. In section II, we review the previous work on risk attitudes. Section III presents and discusses the corresponding Russian evidence, together with some implications. Section IV describes the basic design and results of public choice experiments, followed by our experimental evidence. The final section V contains general conclusions and suggests some implications, theoretical as well as practical.

II. RISK ATTITUDES: THEORY AND EVIDENCE

Every citizen of the former USSR was familiar to the claim that one of the greatest achievements of 'real socialism' is the 'feeling of certainty in one's future', guaranteed to everybody. Indeed, under the previous system, <u>nearly</u> everybody was eligible to a socially guaranteed minimum, and this is <u>almost</u> regardless of his or her effort level. By contrast, in transitional times nearly nobody was guaranteed anything, to some extent also regardless of effort level. The question is: how individuals who were subject to such a change, behave toward risk?[1]

Through this paper «risk» is understood according to the conventional criterion most widely used in economic theory. Risky environment in ex-

[1] The communist system being expired, no conjecture can be made nowadays as to which were risk attitudes by the citizens of the former USSR, since life experience and institutional environment has changed since.

periments is generated by facing subjects with lists of lotteries (risky prospects) of the type (x, p; y, 1-p), where x and y are outcomes in real or experimental currency, and p - probability of the favourable outcome's occurrence. The baseline (von Neumann-Morgenstern) expected utility theory predicts or forces the rational individual to choose one among the offered lotteries according the expected utility criterion:

max $E[u(x)] = \sum_i u(x_i)p_i$,

where x_i is the ith element of a vector of possible outcomes, and p_i - the probability of outcome x_i, $\sum_i p_i = 1$. The von Neumann-Morgenstern utility function u, defined up to positive affine transformations, characterises both the utility of outcome and individual attitudes toward risk. If u is linear, the individual is said to be risk neutral or expected value maximizer; individual with concave u would prefer the expected value of a lottery for sure to the lottery itself, which means risk aversion; convex u means the reverse, and this is the case of risk seeking (Pratt, 1964). A good deal of experimentalists' attention was paid to the tests of necessary and sufficient conditions for the existence of the u function with the above properties (e.g. Kahneman and Tversky, 1979), and in fact, little support was found to the baseline theory, and probably even less - to its extensions and generalizations (Hey and Orme, 1994). However, these discouraging results do not interfere with the study of risk attitudes *per se*, since the latter is rather descriptive in nature: the mere statement of preferences among lotteries suffices to qualify these as risk-averse or risk-seeking.

A large body of Western literature is dealing with that particular subject (e.g. Kahneman and Tversky, 1979; Payne e.a., 1981; Cohen e.a., 1987; Tversky and Wakker, 1995, to mention only a few). The commonly observed preference pattern that stems out of this literature reveals risk aversion for gains and risk seeking for losses when probabilities of high outcome (by absolute value) are non-negligible, and significant overweighing of very small probabilities, which leads to risk seeking for gains and risk aversion for losses. For instance, a typical amount of money that is exactly as desirable as the lottery itself, or its *certainty equivalent* for two-outcome lottery like (100, p; 0, 1-p)[2], might be 40 at p=0.50 and 5 at p=0.01; being equal to -30 at p=0.50 and -10 at p=0.01 when the outcome of 100 is taken with negative sign. Instead of asking subjects for their certainty equivalents, elicitation of corresponding probabilities or outcomes may be used for the same sake (see Farquhar, 1984 for a review). Alternatively, risk attitudes may be estimated by revelation of preferred lottery in a pair where one lottery is riskier than another (usually in the sense of mean preserving spread - Rothschild and Stiglitz, 1970), while the maximum possible gain is higher in the other.

[2] In what follows lotteries of that sort are labelled *standard*

Any meaningful comparison of risk attitudes exhibited by Russian subjects to those observed by Western scholars would make sense as long as substantial isomorphism is established between experimental conditions in both cases, including satisfaction of saliency, privacy and dominance requirements of experimental design. Two classical cross-cultural studies were performed in developing countries - rural India (Bingswanger, 1982) and urban P.R of China (Kachelmeier and Shehata, 1992). Bingswanger asked about 120 Indian peasants to choose one out of eight lotteries of the form (H, 0.5; L, 0.5), with H varying from 50 to 200 and L - from 0 to 45, multiplied by 0.01, 0.1 and 1 rupees for three real, and by 10 - for one imaginary-payoff scale. He found relatively high (up to $^1/_3$) proportion of extremely risk-seeking choices under low payoff scale, but such a pattern virtually disappeared for higher payoff scales. This method is rather restrictive since it allows for point estimates only, and risk aversion measures have to be implicitly imputed (the author realized this, but he was forced to proceed in that way because the illiterate peasants failed to understand the alternative equivalents formulation of the task). Kahelmeier and Shehata dealt with more educated sample of 80 Chinese students, and compared these results with analogous data obtained using US and Canadian students samples. They asked subjects to state certainty equivalents (as willingness-to-accept) for 20 standard lotteries of a form (x, p; 0, 1-p) with x fixed at low (0.5 or 1 yuan) or high (5 or 10 yuan, respectively) scales, and p varying from 0.05 to 0.95. To simulate revelation of the true selling prices, the Becker-DeGroot-Marschak (BDM, 1964) procedure was used. This well-known mechanism consists in announcing the subjects that their stated selling price will be compared to a random price drawn from some predetermined uniform distribution. Would the random price exceed the selling price, the subject receives the random price (not her stated price) instead of the lottery, while in the opposite case she will have to play the lottery and to collect its outcome, whatever it will be[3]. It is easy to see that the only dominant strategy in this case is to state the true selling price, since any deviation results in an expected utility loss. The argument follows the logic of optimal bids in second-price auctions: suppose the subject's stated selling price is above the true one. Then the random number is to fall in-between the true and the stated selling price with some nonnull probability, and the subject will have to play the lottery while forgiving the option to collect an amount that exceeds his

[3] BDM mechanism in the above form is used to elicit minimum selling price, or willingness to accept (WTA). A dual mechanism can be used for the case of maximum buying price, or willingness to pay (WTP): if the random repurchase price will be below or at the stated price, the lottery is acquired for the random price and played; otherwise it expires worthless for the subject.

true valuation. Conversely, by understating the true valuation an individual makes it possible for the random number to be larger than the stated price, but smaller than the true one, which means that the subject has to collect an amount that is below his valuation. Therefore, the only dominant strategy under the BDM mechanism is to bid the true valuation.

This method, while being logically impeccable, is not free of some drawbacks. First, its efficiency obviously depends on how well the subjects understand it (in fact, the same is true of any other elicitation mechanism). Second, the interval from which the random price is drawn was shown to influence the stated prices (Bohm e.a., 1997). Finally, even theoretically it works exactly as described above if and only if the subjects are expected utility maximizers in the sense of von Neumann-Morgenstern. In particular, it is easy to see that the BDM mechanism defines a two-stage lottery over the final outcomes of the lottery being assessed, and thus it can be shown to reveal the true valuations provided the independence (Hold, 1986) or reduction of compound lotteries (Segal, 1988) axiom of the expected utility theory are not violated. Existence of a number of generalized expected utility theories that abandon these axioms gave rise to an extensive critique of the BDM procedure in the literature, which accused it to lead to the uncontrolled distortions of individual preferences (e.g. Safra e.a., 1990). However, subsequent experimental research (e.g., Tversky e.a., 1990) have shown that observed choice phenomena persisted under alternative elicitation procedures, and thus the critique of 1980th largely misses its target. In either case, the intuitively clear BDM procedure probably remains the most popular elicitation mechanism, so we implemented it in our experiments mostly for calibration reasons.

Using the certainty equivalents elicited with the BDM mechanism, Kahelmeier and Shehata found significant risk seeking on the average for the probability range below 0.20 or 0.25, but for higher probabilities the average certainty equivalent was almost precisely equal to the expected value, revealing risk neutrality. Risk aversion of the Chinese subjects generally increased with the scale of the game: for instance, a 5 yuan scale treatment gave persistently more risk-averse assessments than 0.5 yuan scale. This difference disappeared, however, with the North American subjects (students from Canada and the US who played 25 games with $1 stakes and an additional couple for $20 stakes), where the two series were nearly identical under both high and low scales. For calibration sake we choose to take as basic the latter approach, but supplemented it with pairwise choice tasks, with one lottery in a pair being more risky than the other. The two formulations can be expected to give different results for two reasons. First, an assessment through pairwise choice obviously is truncated by nature in comparison to the certainty equivalent assessment. Second, any ordering or evaluation may be suspect due to the preference reversals phenomenon (Lichtenstein and Slovic, 1971; Tversky e.a., 1990).

With these caveats in mind, we have chosen the certainty equivalent design for the baseline experiment, since it is readily comparable to the previously obtained data. To enhance calibration even further, we tried to ensure compatibility of subjects' payoffs. Kahelmeier and Shehata played in China 25 low-scale and 25 high-scale games for real money, which was possible since the average monthly income is reported to be as low as 60 yuan ($15), and so a single 10-yuan bet represented about 1/6 of subjects' regular income. Our subjects for the analogous experiments were first-year undergraduate Russian students whose regular monthly income (stipend) was typically about 120,000 roubles ($20), and normally they cannot be expected to have significant sources of additional income. Moreover, a structure of their spendings is also similar to that of Chinese students, rental expenses constituting only a few percent of total living costs. For financial reasons we did not play every lottery,- instead, after making their choices, individuals drew two out of twenty lotteries in both low-scale and high-scale games, and played them subject to the BDM procedure[4]. Our subjects apparently had no difficulties to grasp that the positive outcome in low and high-scale game was at 2,000 and 20,000 roubles, the latter of these being thus equal 1/6 of regular income, which made subjects very happy with their actual wins. Thus, our stakes in real terms were essentially analogous to those of Chinese 1 and 10-yuan games, albeit our subjects played only a selection of lotteries they have assessed. Despite this difference, results obtained by us were essentially very similar to the previous, as will be seen shortly.

III. RISK ATTITUDES IN RUSSIA: DESIGN AND EVIDENCE

Our experiments were ran in Moscow area during Spring and Fall semesters 1997. Subjects were volunteer 1- and 3-year undergraduate students recruited through oral advertisement, mostly at the Economic Faculty of Moscow State University. In addition to these, two sessions were ran at Higher School of Economics, two more at Moscow Transport Engineer University (MIIT) with 3-year students in civil engineering, finally, one session was played at Dubna university, region of Moscow, with local students in economics[5].

[4] Another advantage of playing selected lotteries rather than every lottery in the list is that this method seems to exclude the possibility of significant influence of wealth effects, which may potentially distort individual preferences.

[5] Every experimental session usually contained one to two other cells following those reported below. Where their contents goes beyond the scope of the present paper, it will not be discussed here.

a) Experimental design

All the sessions above were ran in a similar manner. Upon distributing the general instructions (sample of which is provided in the Appendix 1), subjects were introduced to the notion of a lottery, and endowed with separate lists of two-outcome lotteries stated in experimental currency (francs), e.g. (100, 0.5; 0, 0.5). For ease of perception, each lottery was accompanied with a pie chart representing probabilities of outcomes. In the first list, lotteries were arranged in ten pairs, and the subjects had to select one lottery in each pair they prefer to play. Expected gains within every pair were similar up to a couple of francs, while variance of outcomes in one lottery was higher than that in the other, so the former was riskier . To prevent reasoning by analogy, riskier and safer lotteries for every pair were actually permutated at random. Prior the choice, the subjects were informed that after their decisions will be made, two out of ten pairs of lotteries will be selected at random, and they will have to play a lottery they preferred in these two pairs. All choices being made, the experimenter called lotteries consecutively, and the subjects indicate the lotteries to be played for them by raising their hands. Outcomes were revealed with wooden balls enumerated from 1 to 100 and contained in an opaque bag. If the number generated was at or below the low-outcome probability, the subject received the lower payoff; otherwise he or she won. After a sequence of questions no subject apparently found it troublesome to handle with this procedure.

After this was done, the first lists were collected and the subjects received the second one containing standard lotteries of a form (100, *p*; 0, 1-*p*), as well as some nonstandard two-outcome lotteries (see list of lotteries in the Appendix 1). Standard lotteries with 20 different *p*'s (0.05, 0.10, 0.90, 0.95, 0.99) were arranged at random, but the order remained the same through the sessions being reported. The BDM mechanism was then introduced, including three dry runs to give subjects a better feeling of its properties. Upon filling the whole list with certainty equivalents every subject was privately assigned two or three (depending on the list size) lotteries, and when everybody did so, the experimenter called lotteries by numbers in turn. Those participants whose lottery was announced indicate this by raising their hands, and a random price was been generated with the table of random numbers. Subject to BDM conditions, a lottery was played as before. Regardless of the outcome, everybody had to fill in the form reflecting outcomes and decisions (stated prices).

b) Risk attitudes via certainty equivalents

In total, 186 participants ook part in our experiments; however, only 87 of these were have gone through the experiments on risk attitudes by certainty equivalents in standard lotteries, which coincides with sizes of Chinese and American samples by Kahelmeier and Shehata. Basic features of these sessions are provided in table 1.

Table 1. Summary of experimental sessions on risk attitudes

#	N	Scales	Location	Incentives	CE revelation
1a	34	low	MSU	money	min selling prices
1b	28	high	MSU	money	min selling prices
2	10	low	MSU	money	max buying prices
3	15	low	Dubna	prizes	min selling prices
4	11	low	MIIT	prizes	min selling prices
5	17	low	HSE	prizes	max buying prices

Since the first results were highly similar regardless of institutional affiliation of the subjects, we choose to concentrate on two treatment variables. One of these were incentives: although outcomes were throughout stated in experimental currency (francs), not in real money, conversion rules differed across samples as it was announced prior to the beginning of every session. In some sessions, in addition to the participation fee of 10,000 roubles, subjects collected actual money gained as lotteries' outcome according to the announced exchange rate set at 20 roubles per one franc for the low-scale games. In others, subjects were to get «valuable prizes for their participation, whose worth will be directly proportional to the number of francs they will earn»[6]. The other variable was a form of certainty equivalent revelation: 60 subjects were asked to write down their minimum selling price for the lottery they own, the remaining 27 were to state the maximum price they are ready to pay for a lottery. At least one session was ran at every possible combination of each treatment variable, and one more session (session 1b) was played with the same subjects as session 1a, but under high-scale conditions, with high outcome being 1000 francs instead of 100 for low-scale conditions.

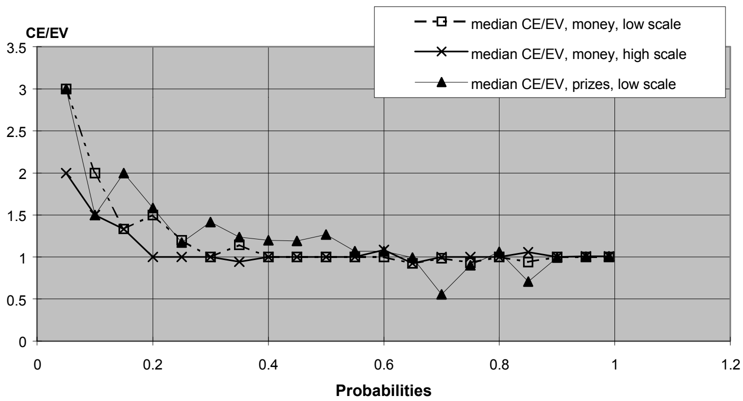
Upon collecting the certainty equivalents in either form, a natural measure of risk attitudes is the ratio of average (arithmetic mean or median) certainty equivalent to the expected value of every lottery. These ratios for the medians in our experiments (those for means are very similar) are plotted in Figure 1 for two different samples: one was played for real money by 34 subjects; another consisted of 26 subjects who played for

[6] Actually, prizes were small stuff of general student use (pens, pencils, notepads) or Christmas postcards. In the course of the sessions subjects were given no insight as to what these prizes will be.

nonmonetary prizes. In addition, the third series for 28 subjects depicts the same ratio for the high scale lotteries (with 20,000 roubles at stake).

Results of this experiment in China show that CE/EV ratios were at approximately 3 to 4 for the initial probability values (significant risk-seekkng), but sharply decreased to the unity since probability of 0.20-0.25, at which level they remained for the rest of probability range. Corresponding series for the high-payoff case were consistently below the former series, indicating higher risk aversion and slightly declining from about 1.4 to 1.1 for the highest probabilities. Series for North American subjects were slightly below Chinese series at very low probabilities, and fluctuated between 1.5 and 1 at higher probabilities. High-scale games in North America were ran either for hypothetical payoffs or at only one probability level (0.50) with $20 stake. The hypothetical series nearly coincide with those constructed for low-scale lotteries obtained with these samples (Kachelmeier and Shehata, 1992).

Figure 1. Certainty equivalent ratios



As Figure 1 convincingly demonstrates, the basic pattern for the Russian subjects was the same; the risk-seeking in the low probability range coincides with the typical pattern of risk preferences. However, the average CE/EV ratio for the Russian sample lies below the Chinese data, although they are close to the American samples, being clustered between 2 and 3 for the lowest value of p. On the other hand, for higher probabilities, the Russian CE/EV ratio, like the Chinese, was anchored to 1, and, thus, indicated risk seeking for an even narrower range and no readily discernible risk aversion. The Russian results are distinguished by (1) the lack of any systematic differences between the low and high payoff series, at least for probabilities above 0.3, and (2) the somewhat larger, as compared with the American sample, volatility of the series obtained from the prize games. This leads to the conclusion that while the average risk attitudes of Russian subjects do not generally differ from those observed worldwide, their preferences for risk, as measured by certainty equivalents, lie somewhere in-between those observed in developed and developing countries.

Kachelmeier and Shehata performed some statistical tests concerning relative risk attitudes. First, they quantitatively estimated the CE/EV ratios for individual certainty equivalents using the following linear regression specification:

$$CETOEV_{hij} = \alpha + \beta_1 SCALE_h + \sum_{i=1}^{20} \beta_{2i} PROB_i + \sum_{j=1}^{n-1} \beta_{3j} SUBJECT_j + \varepsilon$$

where CETOEV is the observed CE/EV ratio, SCALE equals 0 if the observation comes from the low-scale game, and 1 if it comes from the high-scale game; $PROB_i$ equals 1 if the observation comes from the lottery with $p=i$, i=0.05, 0.10, 0.95, 0.99, and 0 otherwise; and $SUBJECT_j$ equals 1 for observations from subject j, -1 for observations from subject n[7], and 0 otherwise. This regression was estimated using the sample that played the game for money. The results are presented in Appendix 2, Table 2.

As the joint F-test shows, the regression is significant overall, and the correlation coefficients are similar to those observed by Kachelmeier and Shehata, which ranged from 0.33 to 0.43. The significance of the regression coefficients for the lower probabilities supports our hypothesis of significant risk-seeking for that range. However, the scale-of-the-game influence in our case was smaller (Kachelmeier and Shehata obtained a significant coefficient for that variable for the Chinese, but not for the American sample), and our t-statistics for the higher probabilities regressors are higher than theirs. Thus, for the Russian sample, the tendency to anchor certainty equivalents to the expected values in higher probability lotteries was somewhat more articulated than for the Chinese one, whereas in the American case risk aversion was even more pronounced.

These differences in our findings might be interpreted in the following manner. In a general equilibrium framework, subjects can be reasonably expected to be risk averse, for otherwise they will trade at an expected loss, and will shortly become bankrupt. In contrast, this need not be the case in any single market as long as individual assets are sufficiently diversified. Individuals who naturally view experimental lotteries as *only one* of their assets (indeed, a very occasional one), may well interpret this gamble as an amusement rather than earning activity, and thus exhibit greater risk seeking. However, when the scale of the game increases, higher incentives push individuals toward a reinterpretation of gambling as

[7] This specification, which is statistically equivalent to the usual coding ($SUBJECT_j$=1 for jth subject, 0 otherwise), equates the overall regression intercept with the average of the individual intercepts.

a real source of income. Risk seeking thus decreases with the payoff type and scale of the game. At the same time, risk seeking appears to be *increasing* in the proportion of wealth constituted by the amount at stake. Thus, as the scale of the game increases from $1 to $10, Russian students, for whom $10 amount to about half their monthly income, tend to engage in risky gambles more readily than their American counterparts, for whom $10 are no more than a little support towards their monthly allowance, but less readily than the Chinese, for whom this sum constitutes a much more considerable amount. This factor, or *windfall effect*, may be attributed to individuals' inability to promptly adapt to a sudden increase in their wealth position. Note that in the low-scale games, the data for all three countries are remarkably similar.

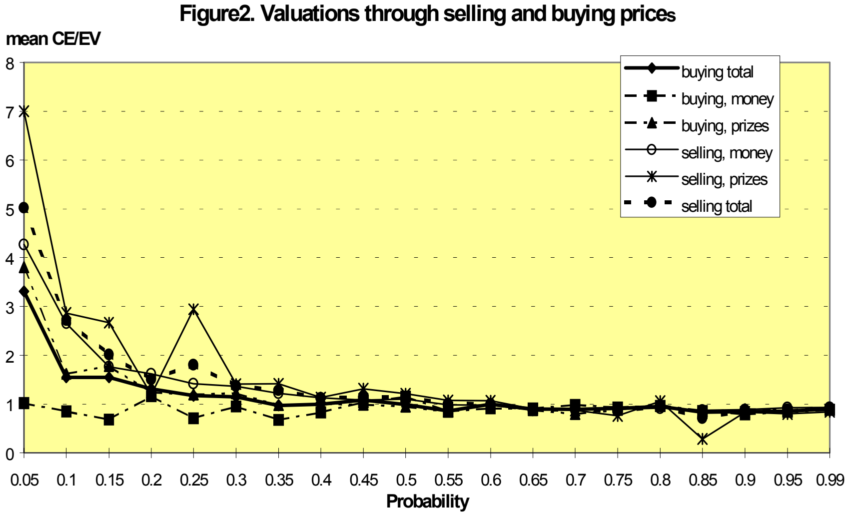
A complementary confirmation of this conclusion could be obtained with a t-test of the null hypothesis that individual CE/EV ratios equal 1 (risk-neutrality) at every probability level. This test was also performed by Kachelmeier and Shehata, who observed significant risk-seeking for low-scale low-probability Chinese games, while t-statistics for high-scale game were mostly insignificant, which again is consistent with risk-neutrality rather than risk aversion. Analogous tests with our sample (Appendix 2, Table 3) show that the difference for the low-scale condition was significant at the 1% level for most low-probability levels (revealing significant risk-seeking), and at the 5% level for the highest probability levels (risk aversion). In contrast, for the high-scale games, we can speak of significant risk-seeking only for the three lowest probability categories, and we are unable to reject the null hypothesis of risk neutrality for the highest probability levels. Thus again, the fact that risk-seeking decreases with the scale of the game is consistent with the hypothesis of changing attitudes towards the experiment: it ceases to be an amusement, and becomes business.

Thus, our data reveal risk seeking over the low probability range but risk-neutrality thereafter. This result coincides with both the Chinese and American patterns, implying that «we all are similar» at least in this particular respect.[8]. Note that risk seeking at low probabilities coincides with the conventional empirical findings discussed in section 2, while risk neutrality stands in contradiction to the usually found risk aversion at the higher probability levels. Kachelmeier and Shehata tend to explain the latter discrepancy along the lines of the WTA-WTP discrepancy. While going against the conventional wisdom of its theoretical equivalence, this WTA-WTP difference has received extensive experimental

[8] One might reason that the country-specific effect is overshadowed by the subjects' shared educational experience. Indeed, one may speculate that economics students are "socialized" to similar norms of "rational" behaviour. Responding to this, however, it might be argued that students tend to be drawn from among the most thoughtful and active parts of the population – i.e., the segment of society from which future decision-makers are likely to be recruited. This endows experiments on students with particular economic meaning.

support (Kahneman *et al.*, 1990). Figure 2 plots the mean CE/EV ratios for 60 minimum selling and 27 maximum buying prices for our sample data. Thin lines denote the patterns of both buying (dashed) and selling (solid) prices, and bold-faced lines show the average patterns for both groups. As stated earlier, the mean selling pattern is similar to that for the median-based general indicator. It is persistently above the mean buying pattern and, thus, supports the WTA-WTP discrepancy. Moreover, our design allows for an analogous t-test of the significance of the CE/EV ratio's deviation from unity, where the CEs are estimated by buying prices (Appendix 2, Table 4).

Figure2. Valuations through selling and buying prices



When t-statistis are calculated for a subsample of sessions played under monetary incentives, in four out of twenty cases the null hypothesis that the average ratio equals 1 cannot be accepted at the 5% level and risk aversion was revealed in all cases. An even larger number of t-statistics become significant for the upper probability range (0.85 and higher) on the basis of the overall sample of buying prices, which again reveals risk aversion for that range (Appendix 2, Table 5). Thus, buying price estimation indicates risk aversion, although its range is somewhat narrower than predicted, being limited to the very high probabilities only.

Yet another regularity tends to support this conclusion: the most conclusive evidence for risk aversion was obtained using prize incentives. According to our results, CE/EV ratios for prize sessions were systematically above those obtained in money sessions (again, this comparison has not been performed by Kachelmeier and Shehata). In fact, as can be seen from figure 2, prize patterns are typically above the money ones. The t-statistic for discrepancies between selling and buying prices with prize incentives was equal to 2.38 (significant at the 0.02 confidence level). It was much less significant for the money regime ($t=1.00$, $p=0.32$). These findings tend to support another conclusion by the aforementioned authors, namely that WTA-WTP differences rather than the increasing relative risk aversion under different incentive regimes, play the crucial role in determining risk attitudes. However, unlike the American evidence, Russian data show low to moderate risk aversion when monetary incentives were introduced.

Nevertheless, our data, in general, not only confirm the basic pattern of risk preferences, they provide, additional support to the hypothesis that the WTA-WTP discrepancy, and not incentive regimes, are of primary importance in determining risk attitudes. MANOVA analysis for our 2×2 factorial design on the basis of average CE/EV ratios for standard lotteries shows that the influence of WTA-WTP as a grouping variable was significant at the 5% level ($F=4.31$, $p<0.04$), while that of the incentive regime was insignificant ($F=1.70$, $p<0.19$), as was the interactive effect[9].

Thus, all our findings agree with risk preference patterns observed worldwide, including incentives and WTA-WTP effects. However, we believe, this finding, in itself, does not suggest that in Russia risk attitudes in economic applications may be assumed to manifest themselves in the same way as in developed countries. To mention one point, as in any other large country, in Russia, the tails of the distribution may well comprise millions of people.

c) Pairwise risky choices

As discussed above, the degree of risk aversion may also be experimentally assessed by the frequency with which a riskier lottery is preferred in a pair with the same expected values over its safer counterpart in a pair (with risk being measured according to the conventional criteria). The data set for this test was larger than for the previous one, since in addition to the standard lotteries used in the five sessions discussed above, two more lottery lists were assessed in seven more sessions. Lottery lists are provided in Appendix 1; the first of these was used in two sessions, the second – was used in five, and the third, with standard lotteries, was used in five. Each list was composed of 10 lottery pairs, each with equivalent expected returns. One lottery (labeled L) had a lower variance than the other (labeled M), while M had a higher potential return. The two were randomly ordered in each pair. The pooled proportions of risk-averse and risk-seeking choices for the 186 subjects are provided in Table 6.

[9] A similar analysis performed with non-standard lotteries (not reported here) confirms the same conclusion.

Table 6. Numbers and proportions of risk averse and risk seeking choices under different incentives regimes.

Choices	Whole sample		Money alone		Prizes	
	number	%	number	%	number	%
averse	637	48.1%	293	48.4%	344	47.8%
seeking	688	51.9%	312	51.6%	376	52.2%
total	1325	100%	605	100%	720	100%

As can be seen from Table 6, the frequencies of risk-averse and risk-seeking preferences under the two incentive schemes were remarkably similar. F-tests on the pooled data revealed that the incentive schemes had no significant effect on the percentage of «risky» choices. Nor did the type of lottery used or the experiment's location.

In order to evaluate the factors that may have led subjects to choose either the riskier or safer lotteries, we used three separate lists (see Appendix 1). The relevant factors might include (1) the expected gain, (2) the comparative riskiness (variance), (3) the values of high and low outcomes within the pair, (4) the probabilities of high and low outcomes, (5) the presence (or absence) of negative payoffs, and (6) the degree to which the lottery's structure can be easily understood without subjective 'editing' --- e.g., Kahneman and Tversky, (1979) round the outcome of 28 to 30 or 25).

On the basis of the general sample, we are unable to identify any well-expressed influence of editing on risk preferences. The first four cases altogether can be analysed using limited dependent econometric techniques. We estimated the log-likelihood function

$$L = \sum_i [(1-y_i)^* ln(1-\pi_i) + y_i^* ln(\pi_i)]$$

for the random utility model of a form

$$y_i = F(.) + u_i$$

where y_i equals either 1 or 0 (such that predicted values of y_i are interpreted as the probabilities of choosing one of the lotteries), u_i is the (heteroskedastic) error term, and $F(.) = F(\alpha+\beta x_i)$ stands for either the logit or probit specification of the six possible explanatory variables: high and low outcomes, their corresponding probabilities, expected values and standard deviations. Logit estimation of the proportion of risk preferences on the basis of pooled lottery lists 2 and 3 provide no significant estimates at all. However, the data may be decomposed in at least two ways: by lottery lists (2 or 3) and by incentives (money and prizes). The significant estimates for the logit models are provided in Table 7 (for list 2, 560 observations and prize incentives) and 8 (list 3, 570 observations and monetary incentives).

Table 7. Estimates of the logit model for risky lottery preferences, list 2

Regres-sor	Final value of the loss function	Chi-squared*	Inter-cept**	t-test*	Slope**	t-test*
H	374.04	7.27 (0.006)	0.93 (0.22)	4.23 (0.00)	-0.002 (0.001)	-2.69 (0.01)
p_H	368.80	17.75 (0.000)	-0.64 (0.26)	-2.46 (0.02)	3.74 (0.90)	4.15 (0.00)
p_L	368.80	17.75 (0.000)	3.09 (0.66)	4.69 (0.00)	-3.74 (0.90)	-4.15 (0.00)
H(prizes)	295.55	5.67 (0.02)	0.88 (0.24)	3.58 (0.00)	-0.002 (0.001)	-2.37 (0.02)
p_H(prizes)	291.06	14.63 (0.00)	-0.71 (0.29)	-2.40 (0.02)	3.82 (1.01)	3.77 (0.00)
p_L(prizes)	291.06	14.63 (0.00)	3.11 (0.74)	4.19 (0.00)	-3.82 (1.01)	-3.77 (0.00)

Notes: *two-tailed confidence level in parentheses;
** standard error of estimate in parentheses

Table 8. Estimates of the logit model for risky lottery preferences, list 3

Regres-sor	Final value of the loss function	Chi-squared*	Inter-cept**	t-test*	Slope**	t-test*
H(money)	198.19	5.61 (0.01)	1.01 (0.45)	2.24 (0.03)	-0.00 (0.00)	-2.35 (0.02)
L(money)	193.81	14.38 (0.00)	0.27 (0.14)	1.96 (0.06)	0.15 (0.04)	3.56 (0.00)
EV(money)	196.25	9.50 (0.00)	1.34 (0.46)	2.90 (0.01)	-0.02 (0.00)	-3.03 (0.00)
STD (money)	196.87	8.29 (0.04)	1.19 (0.43)	2.71 (0.01)	-0.01 (0.00)	-2.84 (0.01)

Notes: *two-tailed confidence level in parentheses;
** standard error of estimate in parentheses

The tables reveal that the insignificance of the coefficient estimates in the pooled data does not persist in the subsamples. Playing list 2 for prizes, the probabilities of high and outcomes were shown to be important in determining risk preference. Playing list 3 for money, however, revealed that outcomes, expected value and standard deviation were important. This evidence offers some support for a commonly recognized motivation for risky choices (as opposed to pricing): probabilities typically receive greater weight than outcomes (Lichtenstein and Slovic, 1971). The attention paid to probabilities in the games played for prizes, in contrast to the emphasis on outcomes in games for money, appears to support this conclusion.

d) Extensions

So far a number of empirical measures of risk aversion have been presented and discussed. The main conclusion which necessarily follows from this evidence is that Russian subjects exhibit risk preferences that are similar to subjects from other countries. In addition, our data confirm particular tendencies observed by previous researchers. These include risk seeking over the small probabilities range in standard lotteries and risk neutrality thereafter (with a moderate tendency to risk aversion when measured by buying prices). These patterns contrast with both the conventional wisdom among economists that risk aversion is more common and the conclusions of psychologists, like Tversky and Kahneman, that risk seeking characterizes low probabilities and risk aversion characterizes higher ones.

One more possible reason for the discrepancies might be that some authors that run experiments on choice do not investigate the distribution of certainty equivalents around their means (or medians). Perhaps this is due to these authors' reliance on the law of large numbers, which, by the way, is only asymptotically valid in finite samples. The main characteristics of the distributions of our valuations are provided in Appendix 2, Tables 9 (for standard lotteries) and 10 (for non-standard lotteries) using both buying and selling prices.

These data suggest that for most lotteries in which the probability of the high outcome lies in the middle range, certainty equivalents tend to be normally distributed around their means. However, the distribution of valuations tends to be skewed in a positive direction for most lotteries with low probability (below about 0.30), and in a negative direction for lotteries with high probabilities above about 0.85. These tendencies hold for both standard and non-standard lotteries, and are even more pronounced in higher scale lotteries of H=1000. These findings presumably should be interpreted as *editing* (Kahneman and Tversky, 1979), or *anchoring* of lotteries with low probability high outcomes to L, and with high probability high outcomes to H. Closer consideration of Table 10 suggests that for non-standard lotteries, positive skewness is more likely to occur when the lower outcome is nonnegative or when the lottery's structure is not easily interpreted, which complicates the editing task.

Distributional patterns of this sort might have important behavioral implications. Suppose, for instance, that the public assesses the probability of a good outcome on some investment project to be rather high. Then the observed pattern implies that many people tend to edit it out to near certainty, and thus take on an unexpected risk.

This observation raises another question: can observed risk attitudes be somehow related to the perception of risk? To deal with this potential problem, we complemented the pairwise choice task in some experiments by asking subjects to indicate which of two lotteries in a pair was more risky. In order to reduce the bias toward the formal definition, the subjects were encouraged to make this judgement exclusively on the basis of their perception. The subjects could, therefore, indicate a preference for one of four combinations. They might select either the formally-defined safe or risky lotteries, which they had accurately identified as such. We denote these choices as «conscious.» Or they might prefer either of the two, having incorrectly identified them according the formal definition of risk. We denote these choices as «unconscious.» The data from these sessions are summarized in Table 11 below. Chi-square tests on the randomness of the unconscious choices are also provided.

Table 11. Consciousness in risky choice

Preference for	risk (χ^2)	% (P)	safety (χ^2)	% (P)	Total (χ^2)	% (P)
Conscious	380	35.0%	480	44.2%	860	79.1%
Unconscious	175	16.1%	52	4.8%	227	20.9%
Total	555	51.1%	532	48.9%	1087	100%
Chi-square, Prob	55.18	0.00	5.08	0.02	47.40	0.00
Lotteries list 1						
Conscious	14	28.0%	17	34.0%	31	62.0%
Unconscious	17	34.0%	2	4.0%	19	38.0%
Total	31	62.0%	19	38.0%	50	100.0%
Chi-square, Prob	9.32	0.00	0.21	0.65	7.22	0.00
Lotteries list 2						
Conscious	120	28.8%	136	32.6%	256	61.4%
Unconscious	127	30.5%	34	8.2%	161	38.6%
Total	247	59.2%	170	40.8%	417	100.0%
Chi-square, Prob	58.29	0.00	6.08	0.01	62.16	0.00
Lotteries list 3						
Conscious	246	39.7%	327	52.7%	573	92.4%
Unconscious	31	5.0%	16	2.6%	47	7.6%
Total	277	44.7%	343	55.3%	620	100.0%
Chi-square, Prob	3.47	0.06	0.74	0.38	3.56	0.06

Recall that lotteries in list 1 were denominated in roubles, with probabilities listed as fractions of 36, while list 2 outcomes were recorded in francs, and probabilities in decimals. These variants did not appear to influence the nature of risk perception. These outcomes agree with the pooled patterns. Nearly every individual who prefers the safer option does so consciously, while about half of all risk-seekers choose the risky lottery while thinking they preferred the safer prospect. Clearly, this discrepancy cannot be ascribed to random errors. For list 3 alone, however the «unconscious» preferences may be ascribed to random errors for both risk-averters and risk-seekers, although the proportion of «unconscious» choices was again higher for the latter. This phenomenon requires more thorough investigation. Our evidence, however, does point to the conclusion that risk perception is more ‘correct’ when subjects are offered standardized lotteries, which require little or no editing. In other circumstances, various biases can be expected to emerge.

IV. PUBLIC CHOICE GAMES

We conducted a complementary sequence of experiments relating to voluntary public good provision, along the lines of the work by Marwell and Ames (1979) and followed by Isaac *et al*. (1984), and Kim and Walker (1984). In the simplest version of these experiments, individuals are arranged in groups and asked to split some endowment T (which we set equal to 10 experimental francs) into two parts. One of these parts will be placed in a private account, which generates an income of 1 per 1 unit invested. Another part goes into a public account, which generates a smaller income (say, 0.3 per 1 unit invested). This rate is called the *marginal per capita return* (MPCR). Formally, each individual's payoff X in each investment period may be written as

$$X_i = [T-t_i] + g(\Sigma_i\, t_i)$$

where t_i is individual contribution to public account, g is the (*linear*) public good production function (set at g=0.3$\Sigma_i\, t_i$ in our experiments), and the summation is performed over the range of subjects in the group. An individual's income from their private account is thus shown by the expression in the square brackets (which, in the generalized case, might also be multiplied by a real constant). A unit deposited into an individual's account will produce a greater payoff to that individual than one invested in the public account. Investments in the latter, however, will be shared by all and, are thus, a public good. Thus, even though setting t_i=T may be the socially efficient strategy (which is the case when the amount in the public account exceeds by 10/3 the amount of a single individual's endowment), the equilibrium contribution to the public account is zero so long as MPCR<1.[10]

Nevertheless, Marwell and Ames found from their experiments that about × of T was contributed to the public good. This unexpectedly high rate increased when the group was informed that one of its members had an MPCR above unity. It did not vary, however, with the size of the endowment, the group size, their level of experience, or the MPCR. However, Isaac *et al.*, as well as Kim and Walker have shown that contributions to the public account decrease rather rapidly when the game is repeated, although it never fully reaches the equilibrium value of zero. Additional findings include the public contribution increasing with the MPCR, pre-play communication and (somewhat surprisingly) group size. In view of the fact that our experiments are probably the first run in Russia in this field, we used the simple public choice design described above. From a number of possible treatment variables (see Ledyard, 1995 for a reference list), we focused on the effects of pre-play communication and gender. From our seven groups, three were allowed to engage in pre-play communication. These sessions lasted six periods, and the revealed contribution trend was quite strong. In the other four sessions, play lasted for ten periods, and no communication was allowed. Four of our sessions were run at MSU (the three communication sessions, and the remaining one, without communication, was run with HSE students), two in HSE and one in MIIT. Aside from the gender composition of the groups, the other parameters in the experiments were held equal. The groups' size was set at 8 inexperienced subjects, their MPCR was fixed at 0.3; all shared identical initial endowments of 10 francs per period per subject (1 franc worth 100 roubles, so that the full endowment for the game was of 10,000 roubles[11]); and information was distributed symmetrically among the players. All players were also provided with and shown how to use the same MPCR tables.

The contribution rates, which are shown in Figure 3, suggest two conclusions. First, the effect of pre-play communications is clearly pronounced. The average contribution rates for the three communication sessions were 0.87, 0.95 and 0.88. On the other hand, the groups playing under the non-communication regime turned up smaller average contribution rates of 0.28, 0.31, 0.71 and 0.39.

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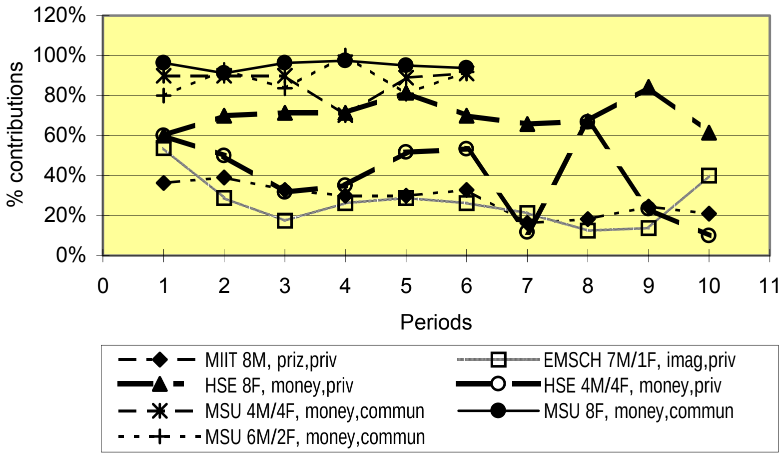
[10] The first-order conditions of maximization of expected payoff for each bidders gives $g'(\sum_i t_i)=1$, where $g'(.)$ is MPCR. At any $g'(\sum_i t_i)<1$, the equilibrium contribution rate t is zero. Moreover, since the income from public account $g(\sum_i t_i)$ is the same for every member of the group, putting money in that account would be efficient if $Ng'(\sum_i t_i)>1$. These two conditions define $1/N<g'(\sum_i t_i)<1$ and describe when free-riding is profitable.

[11] For organizational reasons, two of seven groups (one from MIIT and the other from MSU) played for non-monetary prizes. This difference is unlikely to be responsible for any of the variation in the experiment's results, since the responses from these two groups were in line with those from others.

@The second noteworthy finding is that contribution rates under the non-communication regime rose with the percentage of female participants in the group. The gender composition of the group did not appear to influence contributions when players were allowed to communicate. But under the no communication regime, the smallest average contribution of a single person in an all-female group was 50%, which was greater than the highest average contribution in an all-male group. This finding is not well-documented in Western literature. Few works have dealt with the effect of gender on contribution rates. «[T]he question remains open» (Ledyard, 1995, p.161). Our data are suggestive of a cooperative attitude among Russian women. In other words, they appear less inclined to free-ride. An alternative explanation might be that females are just more careless than males in their expenditure decisions. Testing these alternative hypotheses would not appear to be too difficult.

Figure 3. Public choice games



Some other interesting observations can be made with respect to this evidence. No group ever produced the equilibrium contribution of zero. This finding contradicts game theoretic wisdom but coincides with Western experimental evidence. The contribution rates of the subjects in our experiments decreased less rapidly than those of non-Russian subjects that took part in similar experiments elsewhere. Gender differences also emerged after a temporary (single-period) decrease in the returns from public investment. Male subjects typically increased their private investment, whereas females put even more into public account. In mixed gender groups, female subjects typically also began by contributing at a high rate to the public account, but when faced with the low level of cooperation from the male members of the group, they reverted to contribution rates that were less than those of purely female groups (the average contribution rate of female participants from a group composed of equal numbers of males and females was only 0.36). This finding is suggestive of a social experience effect. That is, irrespective of initial bids (that may have been a function of prior beliefs and perceptions of the game), most subjects develop contribution rates that mirror those of others in their groups.

Our evidence also reveals slightly higher contribution rates for risk seekers than for risk averse subjects in the opening periods of the game.

* * *

These findings can be complemented by another simple public choice game, played for real money. A group of 8 advanced undergraduates at MSU were offered the following choice. At a site in Moscow, they could buy , for 20,000 roubles, a course packet that included all the assigned readings for a course. They could also buy the packet from their lecturer (namely, myself), if the sum of their independently-written sealed bids for a copy equaled or exceeded the threshold of 10,000 roubles times the number of students in the class (which in our case was 80,000 rubles since the class had eight students). If this condition was met, each student would be asked to pay his or her bid to get a course packet; otherwise, they would have to procure a copy on their own for 20,000 roubles. Thus, the public good consisted in providing everybody a journal in a convenient manner and at a smaller cost. Everybody's bid was sealed and observed by the experimenter alone, not anybody else in the group.

This setup defines a different sort of experiment with a *threshold* as opposed to a linear public good production function. The game-theoretic structure is, therefore, different. Moreover, so long as the journal is conceived of as desirable (which we presume to be the case), the provision of the cooperative outcome is socially efficient. If the threshold was not met, a subject compares $u_i(\mathrm{W})$ with $u_i(\mathrm{W}+J\text{-}20000\text{-}c)$, where W is the subject's wealth, J represents possession of a course packet, 20,000 is its official posted price, and c is the cost of a private arrangement to buy it. On the other hand, if the threshold is met, an individual's payoff is $u_i(\mathrm{W}+J\text{-}t_i)+f_i(10000\text{-}t_i)$, where the first term denotes the private benefit from getting a copy of the course packet, and the second (the function f_i) is the free-riding benefit function, which for every subject i can be assumed to possess the following properties:

$f(0) = 0$

$f(t>10000) \leq 0$ (i.e., being a victim of free-riding brings non-positive utility)

$f(t<10000) \geq 0$ (i.e., being a free-rider brings non-negative utility).

As an obvious corollary, $f(.)$ can be assumed to be decreasing in t.[12]

Each subject's problem is to choose the bid t_i that will maximize his of her utility payoff. The first-order condition for the problem as formulated yields $u_i'(.)=-f_i'(10000-t_i)$, where the left-hand side must be non-negative if the purchase of a course packet is desirable. Since non-positivity of $f_i'(.)$ also follows from the properties of the function $f(.)$, the latter equation can be satisfied. To maximize $f(.)$, t_i should be as small as possible, or the subject should try to free-ride with $t_i \leq 10000$. Combining this requirement with the threshold provision condition $\sum t_i \geq 10000*N$, or $t_i \geq 10000$, we get an obvious focal point of $t_i=10000$ unless $t_i<20000+c$ (i.e., the desirability of the public good provision) is violated, which almost trivially is not the case.

To verbalize this reasoning, knowing the ordinary price of 20,000, the subjects prefer the public good, but also might try to free-ride and bid less that the focal bid of 10,000 in the hopes that someone else who values the course packet will bid an amount greater than 10,000 roubles. In reality, not only nobody bid less than 10,000, but two people bid more, 12,000 and 15,000 roubles, and thus made explicit provision for some free-riding. This behavior might be explained by risk aversion, or the desire to avoid the loss of a desirable public good, since the cost of purchasing it privately would be 20,000+c. (Note, however, that bidding over 10,000 does not guarantee the public good's provision. Apart from risk aversion, the friendly relationship among subjects like my students might explain the rather high contribution rates. Supra-equilibrium contributions may not be considered painful when one's partners are close acquaintances. This type of behaviorhas been confirmed by the Western literature as well (Ledyard, 1995).

In sum, our evidence reveals that the contribution rates of Russian subjects to public accounts tends not to be lower than the level found in other countries. And surprisingly, the rates of Russian females appear to be systematically higher. Furthermore, close inter-personal relations appear to enforce commitment to the cooperative outcome even when subjects may free ride.

V. CONCLUSIONS AND IMPLICATIONS

Our research here represents an attempt to better understand the extent of observable differences among peoples and cultures. Although our experimental evidence is limited, it does suggest that the general

[12] The payoff function for the provisional case may be written in terms of saved money: $W+J+g_i(20000-t_i+80000/N-t_i) = W+J+g_i(30000-2t_i)$, which has a standard public choice environment structure.

pattern of risk preferences revealed by Russian subjects does not differ significantly from that observed in other countries. This evidence might surprise those who think of Russians as being somehow quite different and peculiar. Our findings, however, suggest that there are limits to these similarities. The high contribution rates of Russian women in public choice experiments is clearly exceptional. And Russian subjects, in general, showed a rather unique tendency to anchor their certainty equivalents to the expected value of lotteries in risky choices. And Russians also were unusually unlikely to exhibit risk aversion when the probabilities of positive outcomes were high. These differences, at the individual level, may well be even greater at the aggregate level. True, one might argue that because students traditionally comprise one of society's most educated and cosmopolitan groups, their behavior may vary less across countries than that of countries' average representative individuals. But we do not think that an overall similarity of risk attitudes in Russia and other countries implies that no differences exist between Russian and Western economic agents. Indeed, *if* the basic patterns of individual behavior are to a great extent the same worldwide, then one could expect that the *interactions* of these individuals, channeled through analogous market systems, should lead to the same social outcomes, at least at the limit. But since this is clearly <u>not</u> the case, it seems to us that an explanation of cross-country variation should be sought not in individual behavior but in the patterns and the character of *social* interactions within the given economic and social *institutions*.

But apart from these cultural considerations, a couple of important observations stem from our discussion. First, our data confirm the findings of many previous experiments that risk-seeking preferences are not uncommon. This result flies in the face of the near exclusive use of risk-averse and risk-neutral utility by economic theorists. Our research also suggests that more research should be conducted on the willingness to contribute to public goods.

Certainly, our work represents only a small contribution to the rich literature on individual behavior under uncertainty. Nevertheless, we believe that it convincingly shows that even minor modifications in the institutional or social environment may affect the perception of economic phenomena. We hope that the present work sheds some light on the behavioral patterns in Russia during the transition, and thereby contributes to the understanding of the microeconomic origins of the current economic situation.

REFERENCES

Becker G.M., DeGroot M., Marschak J. Measuring utility by a single-response sequential method // Behavioural Science, July 1964, v.9, p.226-232.

Bohm P., Linden J., Sonnegard J. Eliciting reservation prices: Becker - DeGroot - Marschak mechanism vs. markets // Economic Journal., July 1997, v.107, p.1079-1989.

Cohen M., Jaffray J.Y., Said T. Experimental comparisons of individual behavior under risk and under uncertainty for gains and for losses // Organizational behavior and human decision processes, 1987, v.39, p.1-22.

Farquhar P.H. Utility assessment methods // Management science, November 1984, v.30, #11, p.1283-1300.

Grether D. and Plott C. Economic theory of choice and the preference reversal phenomenon // American Economic Review, 1979, v.69, p.623-638.

Hey J.D. and Orme C. Investigating generalizations of expected utility theory using experimental data // Econometrica, 1994, v.62, p.1291-1326.

Holt C. Preference reversals and the independence axiom // American Economic Review, June 1986, v.76, p.508-514.

Holt C. and Davis D. Experimental economics. Princeton U.P., 1993.

Isaac R.M., Walker J., Thomas S. Divergent evidence on free riding: An experimental examination of possible explanations // Public Choice, 1984, v.43, #1, p.113-149.

Kahneman D., Knetsch J. and Thaler R. Experimental tests of the endowment effect and the Coase theorem // Journal of Political Economy, 1990, v.98, #6, p.1325-1350.

Kahneman D. and Tversky A. Prospect theory: an analysis of decisions under risk // Econometrica, 1979, v.47, p.263-291.

Karni E. and Safra Z. Preference reversals and the observability of preferences by experimental methods // Econometrica, 1987, v.55, p.675-685.

Kim O. and Walker M. The free-rider problem: experimental evidence // Public Choice, 1984, v.43, #1, p.3-24.

Ledyard J.O. Public goods: a survey of experimental research. In: J.H.Kagel and A.E.Roth (eds.). The handbook of experimental economics. Princeton University Press, 1995.

Lichtenstein S. and Slovic P. Reversals of preference between bids and choices in gambling decisions // Journal of Experimental Psychology, 1971, v.89, p.46-55.

Loomes G., Starmer C., Sugden R. Preference reversal: information processing effect or rational nontransitive choice? // Economic Journal, 1989, v.99, p.140-151.

Marwell G. and Ames R. Experiments on the provision of public goods I: Resources, interest, group size and the free-rider problem // American Journal of Sociology, December 1979, v.84, #6, p.1335-1360.

Payne J.W., Laughunn D.L., Crum R. Further tests of aspiration level effects in risky choice behaviour // Management Science, August 1981, v.27, #8, p.953-958.

Pratt J. Risk aversion in the small and in the large // Econometrica, 1964, c.32, p.122-136.

Rothschild M. and Stiglitz J.E. Increasing risk I: A definition // Journal of Economic Theory, 1970, v.2, #3, p.66-84.

Safra Z., Segal U., Spivak A. Preference reversal and non-expected utility behavior // American Economic Review, September 1990, v.80, #4, p.922-930.

Segal U. Does the preference reversal phenomenon necessarily contradicts the independence axiom? // American Economic Review, March 1988, v.78, #1, p.233-236.

Smith V.L. Microeconomic systems as an experimental science // American Economic Review, 1982, v.72, #5, p.923-955.

Tversky A., Slovic P., Kahneman D. The causes of preference reversals // American Economic Review, 1990, v.80, p.204-217.

Tversky A. and Wakker P. Risk attitudes and decision weights // Econometrica, 1995, v.63, #6, p.1255-1280.

APPENDIX 1A. SAMPLE INSTRUCTIONS FOR RISKY CHOICE EXPERIMENT

Москва, ____________ 1997 г.

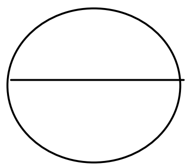
ИНСТРУКЦИЯ УЧАСТНИКУ №______

Вы принимаете участие в экономическом эксперименте по индивидуальному принятию решений в условиях риска в рамках проекта Программы Экономических Исследований. За участие в эксперименте Вы получите реальные деньги. Одна часть этой суммы фиксирована: это Ваш гонорар за участие, который Вы безусловно получите по окончании эксперимента. Другая часть зависит как от Ваших действий в ходе эксперимента, так и от воли случая. Чем внимательнее и тщательнее будете Вы продумывать свои решения, тем выше Ваши шансы выиграть заметную сумму денег, которую Вы получите сегодня же. Таким образом, хотя Вы вольны выбирать *любые* допустимые решения, в Ваших собственных интересах стараться принять те, которые Вы считаете наилучшими.

В процессе эксперимента все денежные величины измеряются не в реальных деньгах, а в условных единицах - *франках*. Ваш выигрыш в рублях будет прямо пропорционален тому количеству франков, которое Вы выиграете. Во франках выражаются все возможные выигрыши и проигрыши. Перечень этих выигрышей и проигрышей (исходов) во франках, совместно с вероятностями их наступления (числа из отрезка от 0 до 1) мы называем ЛОТЕРЕЯМИ. Так, запись

100, 0.50
0, 0.50 100

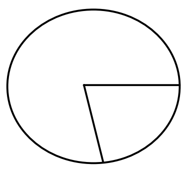
(1) 0



означает лотерею, обладатель которой получит 100 франков с вероятностью 1/2, и не получит ничего (получит 0) также с вероятностью 1/2. Для удобства восприятия вероятности наступления исходов изображаются графически. Еще пример: запись

60, 0.80
-20, 0.20 60

(2) -20



означает лотерею, обладатель которой получит 60 франков с вероятностью 0.8, и потеряет (знак «-» (минус) перед исходом) 20 франков с вероятностью 0.2 и т.д.

В ходе эксперимента Вам надо будет выказывать свое отношение к такого рода лотереям, а некоторые из них будут разыграны, и Вы получите их исход во франках. Розыгрыши будут производиться при помощи бочонков с номерами от 1 до 100, которые вынимаются наугад из непрозрачного мешка. Если выпавший номер оказался *меньшим или равным* вероятности неблагоприятного исхода, то выпадает этот исход, т.е. исходы считаются по возрастающей. Так, в примере (2) бочонки с цифрами от 1 до 20 означают потерю 20 франков, а все цифры выше 21 - выигрыш 60 франков.

ЕСТЬ ЛИ У ВАС ВОПРОСЫ?

ТАБЛИЦА I (первый этап)

Вам предлагается 10 пар лотерей (номера пар даны в крайнем левом столбце). Две из которых будут отобраны случайным образом, и Вы сыграете в них. Внимательно изучите каждую пару, и 1) поставьте галочку (√) в строке рядом с номером той лотереи из каждой пары, в которую Вы бы предпочли сыграть (утверждения «мне все равно» не допускаются), и 2) в строке ниже, рядом со словом *риск* - галочку (√) напротив той лотереи из пары, которую Вы считаете более рискованной. Из каждой пары Вы должны выбрать одну лотерею, которую Вы предпочитаете, и одну (не обязательно ту же самую!), которая кажется Вам более рискованной.

Когда это сделано, вытяните наугад две из десяти предложенных карточек. Число на карте означает ту пару, которая Вам выпала - обведите ее номер кружком. Вы сыграете ту лотерею из каждой из выпавших пар, которую Вы предпочли - занесите ее исход в графу *исход* после розыгрыша. Перенесите Ваш выигрыш за этот этап в ИТОГОВУЮ ТАБЛИЦУ на с.3 инструкции и сдайте Таблицу I ведущему.

ТАБЛИЦА II (второй этап)

У Вас есть возможность сыграть в три из следующих 30 лотерей, которые снова будут отобраны случайно - при помощи карточек. Внимательно изучите каждую из лотерей в списке, и напишите в свободной клеточке сразу справа одно число - - *максимальную цену покупки* каждой лотереи, или наибольшую сумму во франках, которую, Вы согласны заплатить за право сыграть в данную лотерею. Например, Вы, видимо, согласитесь сыграть в лотерею из примера (1) за 0 франков, т.е. бесплатно; с другой стороны, Вы вряд ли согласитесь заплатить за нее 100 франков - сумму, равную максимальному возможному выигрышу. Где-то посередине между этими числами, видимо, и находится та минимальная цена, за которую Вы как раз еще готовы заплатить за лотерею - напишите эту цифру в клетке сразу справа от лотереи. (Проделайте это для лотерей из следующей таблицы)

№	Лотерея	Максимальная цена покупки	Цена предложения	Выигрыш
1	100, 0.50 0, 0.50			
2	90, 0.75; -10, 0.25			
3	110, 0.3; -25, 0.7			

После того, как Вы определите эти цены, Вы вытяните три карточки и отберете три лотереи из полного списка - обведите их номера кружками. Затем при помощи таблицы случайных чисел (с числами от 01 до 99) ведущий случайным образом определит для них *цену предложения*, т.е. ту сумму, за которую он согласится продать Вам каждую из отобранных лотерей. Например, если по таблице выпало число 23, значит цена предложения равна 23 франкам - запишите ее в графе *цена предложения*.

Если выпавшая цена предложения оказалась меньше или равной названной Вами цены покупки, то Вы покупаете лотерею за эту выпавшую цену, и играете ее, записав в графу *выигрыш* разность между ее исходом и ценой предложения. Предположим, что в примере (1) Вы бготовы купить лотерею за 40 франков. Так как продажная цена 23 ниже 40, Вы купили эту лотерею. Пусть ее исход оказался 100 франков - тогда Ваш выигрыш равен ее исходу (100 франков), за вычетом цены предложения (23 франка), т.е. 77 франков - эта сумма заносится в графу *выигрыш*. Если же цена предложения оказалась больше Вашей цены покупки, то Вы не покупаете лотерею, не платите ничего, и в графе *выигрыш* пишете 0.

В Ваших собственных интересах как можно более аккуратно и точно определять *максимальную цену покупки*, так как если Ваша оценка недостаточно точна, то Вы упустите часть возможного выигрыша. Пусть Ваша истинная оценка лотереи (2) равна 44 франкам, а Вы назвали меньшую цену в 35. Тогда если цена предложения попадет в интервал между 36 и 43, то Вы не сможете купить лотерею по цене, которая ниже Вашей готовности заплатить. Напротив, если Вы назвали цену 51, что выше Вашей истинной оценки, то при цене предложения от 45 до 51 Вы купите лотерею, заплатив за нее больше Вашей истинной оценки. Поэтому, определяя цены покупки, Вы должны быть максимально аккуратными. Помните: три лотереи будут случайным образом отобраны из полного списка, и Вы получите или их исходы за вычетом цены предложения, или ничего!

Перенесите Ваши выигрыши за второй этап в ИТОГОВУЮ ТАБЛИЦУ, и сдайте Таблицу II ведущему.

ИТОГОВАЯ ТАБЛИЦА

За первый этап (Таблица I)	
За второй этап (Таблица II)	
ВСЕГО ЗА ИГРУ	

APPENDIX 1B NONSTANDARD LOTTERIES LISTS

LIST 1: Roubles

	H	Prob	L	Prob	EV	STD
L1	4000	35/36	-1000	1/36	3861.1	821.678
M1	16000	11/36	-1500	25/36	3847.2	8061.241
L2	2000	29/36	-1000	7/36	1416.7	1187.317
M2	9000	7/36	-500	29/36	1347.2	3759.838
L3	3000	35/36	-2000	2/36	2805.6	1049.324
M3	6500	18/36	-1000	18/36	2750.0	3750.000
L4	4000	32/36	-500	4/36	3500.0	1414.214
M4	40000	4/36	-1000	32/36	3555.6	12885.057
L5	2500	34/36	-500	2/36	2333.3	687.184
M5	8500	14/36	-1500	22/36	2388.9	4874.980
L6	2000	33/36	-2000	3/36	1666.7	1105.542
M6	5000	18/36	-1500	18/36	1750.0	3250.000
L7	4000	32/36	0	4/36	3555.6	1257.079
M7	21000	6/36	0	30/36	3500.0	7826.238
L8	5000	30/36	-1000	6/36	4000.0	2236.068
M8	30000	10/36	-6000	26/36	4000.0	16124.515
L9	6000	24/36	-2000	12/36	3333.3	3771.236
M9	10000	16/36	-2000	20/36	3333.3	5962.848
L10	2000	30/36	-500	6/36	1583.3	931.695
M10	11000	8/36	-1000	28/36	1666.7	4988.877

LIST 2: Experimental Francs

	H	p	L	1-p	EV	STD
L1	90	0.8	-10	0.2	70.0	40.000
M1	360	0.2	0	0.8	72.0	144.000
L2	67	0.6	-30	0.4	28.2	47.520
M2	200	0.2	-15	0.8	28.0	86.000
L3	80	0.9	-15	0.1	70.5	28.500
M3	240	0.3	-5	0.7	68.5	112.273
L4	50	0.5	-20	0.5	15.0	35.000
M4	250	0.1	-10	0.9	16.0	78.000
L5	28	0.9	-100	0.1	15.2	38.400
M5	125	0.2	-12	0.8	15.4	54.800
L6	80	0.5	-24	0.5	28.0	52.000
M6	135	0.3	-18	0.7	27.9	70.113
L7	60	0.8	-5	0.2	47.0	26.000
M7	160	0.3	-1	0.7	47.3	73.779
L8	55	0.9	-30	0.1	46.5	25.500
M8	120	0.4	-5	0.6	45.0	61.237
L9	70	0.7	-12	0.3	45.4	37.577
M9	120	0.4	-5	0.6	45.0	61.237
L10	50	0.8	-50	0.2	30.0	40.000
M10	100	0.4	-20	0.6	28.0	58.788

LIST 3: Experimental Francs

	H	p	L	1-p	EV	STD
L1	50	0.75	10	0.25	40.0	17.321
M1	100	0.40	0	0.60	40.0	48.990
L2	100	0.70	0	0.30	70.0	45.826
M2	150	0.45	-1	0.55	67.0	75.122
L3	55	0.80	5	0.20	45.0	20.000
M3	100	0.45	0	0.55	45.0	49.749
L4	100	0.60	0	0.40	60.0	48.990
M4	180	0.35	-5	0.65	59.8	88.239
L5	50	0.90	25	0.10	47.5	7.500
M5	100	0.50	0	0.50	50.0	50.000
L6	100	0.65	0	0.35	65.0	47.697
M6	180	0.40	-10	0.60	66.0	93.081
L7	45	0.75	5	0.25	35.0	17.321
M7	100	0.35	0	0.65	35.0	47.697
L8	100	0.75	0	0.25	75.0	43.301
M8	170	0.45	-3	0.55	74.9	86.066
L9	35	0.85	0	0.15	29.8	12.497
M9	100	0.30	0	0.70	30.0	45.826
L10	100	0.55	0	0.45	55.0	49.749
M10	180	0.30	-1	0.70	53.3	82.945

APPENDIX 2. STATISTICAL TABLES

Table 2. Regression output for individuals CE/EV ratios

Dependent Variable: CETOEV

Multiple R: .568

Multiple R-Square: .323

Adjusted R-Square: .293

Number of cases: 1160 F(49,1110)=10.81 p<0.000

Standard Error of Estimate: 1.119 Intercept:1.334

Std.Error:.116 t(1110)=11.513 p<0.000

Regressor	b_i	St. error	t-value	Prob
Intercpt	1.334	3.698	11.513	0.000
SCALE	-0.095	0.063	-1.521	0.129
PROB05	2.288	0.174	13.186	0.000
PROB10	1.241	0.174	7.149	0.000
PROB15	0.422	0.174	2.433	0.015
PROB20	0.006	0.174	0.032	0.974
PROB25	-0.053	0.174	-0.305	0.760
PROB30	-0.054	0.174	-0.312	0.755
PROB35	-0.159	0.174	-0.915	0.361
PROB40	-0.193	0.174	-1.115	0.265
PROB45	-0.211	0.174	-1.214	0.225
PROB50	-0.177	0.174	-1.020	0.308
PROB55	-0.274	0.174	-1.582	0.114
PROB60	-0.250	0.174	-1.440	0.150
PROB65	-0.303	0.174	-1.747	0.081
PROB70	-0.329	0.174	-1.899	0.058
PROB75	-0.331	0.174	-1.907	0.057
PROB80	-0.324	0.174	-1.869	0.062
PROB85	-0.348	0.174	-2.008	0.045
PROB90	-0.323	0.174	-1.861	0.063
PROB95	-0.319	0.174	-1.836	0.067
PROB99	-0.307	0.174	-1.771	0.077

Table 3. T-statistics for mean differences between unit and observable CE/EV ratios

Vari-able	Mean	Standard deviation	t	p	Variable	Mean	Standard deviation	t	p
	4.269	3.698	-4.760	0.000	p1000-05	3.315	3.698	-2.879	0.008
P10	P05	1.990	-4.479	0.000	p1000-10	2.635	2.483	-3.546	0.001
P15	1.768	1.253	-3.300	0.003	p1000-15	1.730	1.255	-3.132	0.004
P20	1.617	0.861	-3.859	0.001	p1000-20	0.968	0.653	0.262	0.795
P25	1.417	0.772	-2.906	0.007	p1000-25	1.041	0.587	-0.374	0.711
P30	1.363	0.763	-2.565	0.016	p1000-30	1.091	0.600	-0.820	0.419
P35	1.224	0.471	-2.558	0.016	p1000-35	1.002	0.460	-0.024	0.981
P40	1.122	0.470	-1.404	0.171	p1000-40	1.027	0.489	-0.299	0.767
P45	1.081	0.449	-0.975	0.338	p1000-45	1.031	0.487	-0.339	0.737
P50	1.106	0.363	-1.577	0.126	p1000-50	1.079	0.367	-1.164	0.254
P55	0.981	0.380	0.267	0.792	p1000-55	0.991	0.414	0.117	0.907
P60	0.977	0.375	0.330	0.744	p1000-60	1.049	0.392	-0.671	0.508
P65	0.871	0.328	2.117	0.043	p1000-65	1.038	0.771	-0.269	0.790
P70	0.901	0.305	1.747	0.092	p1000-70	0.951	0.322	0.825	0.417
P75	0.891	0.275	2.122	0.043	p1000-75	0.957	0.239	0.964	0.343
P80	0.919	0.275	1.597	0.122	p1000-80	0.945	0.316	0.944	0.353
P85	0.875	0.238	2.831	0.008	p1000-85	0.936	0.285	1.217	0.234
P90	0.885	0.242	2.558	0.016	p1000-90	0.981	0.141	0.717	0.480
P95	0.926	0.199	2.002	0.055	p1000-95	0.950	0.173	1.566	0.129
P99	0.933	0.132	2.724	0.011	p1000-99	0.967	0.091	1.932	0.064

Table 4. T-statistics for mean differences between unit and observable CE/EV ratios, estimated using buying prices revealed under monetary incentives only

Variable	Mean	Standard deviation	t	p
P05	1.020	0.727	-0.087	0.933
P10	0.850	0.576	0.824	0.431
P15	0.680	0.446	2.267	0.050
P20	1.160	0.961	-0.527	0.611
P25	0.708	0.521	1.773	0.110
P30	0.953	0.778	0.190	0.854
P35	0.677	0.384	2.662	0.026
P40	0.830	0.416	1.292	0.228
P45	1.038	0.509	-0.235	0.820
P50	1.148	0.415	-1.127	0.289
P55	0.849	0.384	1.243	0.245
P60	0.912	0.321	0.870	0.407
P65	0.912	0.299	0.927	0.378
P70	0.983	0.328	0.165	0.872
P75	0.929	0.282	0.792	0.449
P80	0.963	0.189	0.627	0.546
P85	0.859	0.259	1.724	0.119
P90	0.790	0.270	2.458	0.036
P95	0.840	0.218	2.321	0.045
P99	0.880	0.197	1.934	0.085

Table 5. T-statistics for mean differences between unit and observable CE/EV ratios, estimated using buying prices revealed under monetary and prizes incentives.

Variable	Mean	Standard deviation.	t	p
P05	2.770	4.690	-1.961	0.060
P10	1.333	2.023	-0.855	0.399
P15	1.372	1.614	-1.200	0.240
P20	1.207	1.065	-1.011	0.321
P25	1.016	0.931	-0.090	0.928
P30	1.121	0.791	-0.797	0.432
P35	0.866	0.643	1.076	0.291
P40	0.939	0.418	0.747	0.461
P45	1.007	0.465	-0.082	0.934
P50	1.020	0.324	-0.319	0.751
P55	0.843	0.359	2.270	0.031
P60	0.966	0.306	0.575	0.570
P65	0.889	0.287	2.000	0.055
P70	0.862	0.337	2.118	0.043
P75	0.898	0.242	2.181	0.038
P80	0.979	0.171	0.617	0.542
P85	0.848	0.192	4.078	0.000
P90	0.856	0.216	3.430	0.002
P95	0.860	0.179	4.034	0.000
P99	0.908	0.141	3.358	0.002

Table 9. Characteristics of distributions of certainty equivalents, standard lotteries

Variable	Mean	-95.00%	95.00%	Median	Lower quar-	Upper quartile	Standard deviation	Skewnes	Std. Error skewness	Kurtosis	Std. Error kurtosis
selling prices, scale 100											
P05	25.100	19.281	30.919	20	10	38	18.194	0.584	0.374	-0.560	0.733
P10	27.125	20.985	33.265	20	13	40	19.200	1.406	0.374	2.530	0.733
P15	30.225	23.892	36.558	25	20	45	19.801	1.392	0.374	2.342	0.733
P20	30.000	24.036	35.964	30	15	40	18.649	0.977	0.374	0.783	0.733
P25	45.180	36.114	54.245	40	25	60	27.965	0.713	0.378	-0.623	0.741
P30	41.275	34.830	47.720	40	30	55	20.153	0.541	0.374	0.006	0.733
P35	44.675	38.512	50.838	40	30	53	19.272	1.355	0.374	3.231	0.733
P40	45.050	39.605	50.495	40	40	50	17.025	0.290	0.374	0.816	0.733
P45	51.525	44.824	58.226	50	40	58	20.952	0.977	0.374	2.791	0.733
P50	56.725	51.176	62.274	50	50	60	17.352	1.291	0.374	1.152	0.733
P55	55.350	48.606	62.094	55	45	60	21.088	0.439	0.374	0.824	0.733
P60	60.125	53.497	66.753	60	50	70	20.726	-0.316	0.374	0.241	0.733
P65	57.143	50.623	63.662	60	50	65	20.384	0.071	0.374	0.279	0.733
P70	62.475	55.661	69.289	67	50	80	21.306	-0.111	0.374	-0.714	0.733
P75	64.150	56.631	71.669	65	60	78	23.511	-0.838	0.374	0.478	0.733
P80	76.525	68.472	84.578	80	73	100	25.180	-1.340	0.374	1.210	0.733
P85	60.525	50.960	70.090	68	40	90	29.907	-0.443	0.374	-1.016	0.733
P90	78.448	71.809	85.086	85	70	90	20.758	-1.588	0.374	2.554	0.733
P95	84.650	77.899	91.401	93	83	98	21.108	-2.035	0.374	3.879	0.733
P99	89.850	84.519	95.181	99	90	100	16.668	-1.896	0.374	2.507	0.733

Variable	Mean	-95.00%	95.00%	Median	Lower quartile	Upper quartile	Standard deviation	Skewnes	Std. Error skewness	Kurtosis	Std. Error kurtosis
selling prices, scale 1000											
P1000-05	165.759	83.400	248.117	100	50	135	216.517	2.828	0.434	8.371	0.845
P1000-10	263.483	169.039	357.927	150	100	395	248.289	1.637	0.434	2.417	0.845
P1000-15	259.483	187.878	331.088	200	150	300	188.245	1.676	0.434	3.661	0.845
P1000-20	193.655	143.989	243.321	200	100	250	130.570	1.113	0.434	2.000	0.845
P1000-25	260.207	204.363	316.051	250	150	300	146.812	0.698	0.434	1.781	0.845
P1000-30	327.414	258.914	395.914	300	200	400	180.082	1.152	0.434	2.932	0.845
P1000-35	350.724	289.471	411.978	330	270	400	161.033	0.614	0.434	1.911	0.845
P1000-40	410.862	336.462	485.262	400	300	475	195.595	0.933	0.434	2.352	0.845
P1000-45	463.793	380.398	547.189	450	400	500	219.242	0.762	0.434	1.871	0.845
P1000-50	539.655	469.860	609.450	500	430	650	183.488	0.069	0.434	0.981	0.845
P1000-55	545.035	458.444	631.625	550	400	600	227.642	0.388	0.434	0.317	0.845
P1000-60	629.310	539.855	718.766	650	500	710	235.174	-0.601	0.434	0.570	0.845
P1000-65	675.000	484.335	865.665	600	500	700	501.248	3.678	0.434	17.364	0.845
P1000-70	665.517	579.854	751.180	700	600	800	225.204	-1.093	0.434	1.304	0.845
P1000-75	717.931	649.776	786.086	750	700	800	179.177	-1.261	0.434	2.277	0.845
P1000-80	755.690	659.536	851.843	800	700	900	252.784	-1.269	0.434	2.124	0.845
P1000-85	795.345	703.341	887.349	900	700	935	241.875	-1.771	0.434	2.767	0.845
P1000-90	883.069	834.677	931.461	900	800	950	127.221	-1.688	0.434	2.872	0.845
P1000-95	902.207	839.672	964.742	960	850	1000	164.401	-3.076	0.434	11.700	0.845
P1000-99	957.617	923.282	991.952	1000	900	1000	90.265	-2.753	0.434	8.450	0.845

Variable	Mean	-95.00%	95.00%	Median	Lower quartile	Upper quartile	Standard deviation	Skewnes	Std. Error skewness	Kurtosis	Std. Error kurto-sis
buying prices, scale 100											
P05	5.100	2.500	7.700	5	1	5	3.635	0.681	0.687	0.440	1.334
P10	8.500	4.380	12.620	10	1	10	5.759	0.506	0.687	0.531	1.334
P15	10.200	5.410	14.991	10	5	14	6.697	0.239	0.687	-0.866	1.334
P20	23.200	9.457	36.943	18	10	23	19.211	1.836	0.687	3.869	1.334
P25	17.700	8.385	27.015	10	10	18	13.022	1.735	0.687	2.096	1.334
P30	28.600	11.897	45.303	20	15	33	23.349	2.365	0.687	6.272	1.334
P35	23.700	14.096	33.304	20	10	28	13.425	1.034	0.687	0.192	1.334
P40	33.200	21.297	45.103	38	10	41	16.639	-0.076	0.687	-0.865	1.334
P45	46.700	30.300	63.100	41	25	50	22.925	0.851	0.687	0.401	1.334
P50	57.400	42.550	72.250	50	40	65	20.759	0.958	0.687	-1.014	1.334
P55	46.700	31.600	61.800	43	30	59	21.108	0.567	0.687	-0.748	1.334
P60	54.700	40.923	68.477	54	35	68	19.259	0.445	0.687	-0.700	1.334
P65	59.300	45.388	73.212	55	40	65	19.448	1.060	0.687	0.759	1.334
P70	68.800	52.384	85.216	67	50	85	22.948	0.150	0.687	-1.354	1.334
P75	69.700	54.566	84.834	68	50	81	21.156	0.315	0.687	-1.131	1.334
P80	77.000	66.177	87.823	78	60	88	15.129	-0.328	0.687	-0.336	1.334
P85	73.000	57.255	88.745	80	40	85	22.010	-0.739	0.687	-0.474	1.334
P90	71.100	53.706	88.494	69	50	90	24.315	-0.127	0.687	-1.052	1.334
P95	79.800	64.986	94.614	88	55	96	20.709	-0.580	0.687	-1.282	1.334
P99	87.100	73.182	101.018	93	70	99	19.456	-2.171	0.687	4.795	1.334

Table 10. Characteristics of distributions of certainty equivalents, non-standard lotteries

H	p	L	1-p	EV	Mean	-95%	95%	Median	Lower Quartile	Upper Quartile	Standard deviation	Skewness	Std.Error Skewness	Kurtosis	Std Error Kurtosis
selling prices															
250	0.1	-10	0.9	16.000	58.636	30.535	86.737	35	20	55	63.38	1.849	0.491	2.687	0.953
125	0.2	-12	0.8	15.400	43.046	30.920	55.171	40	20	50	27.349	1.263	0.491	1.808	0.953
200	0.2	-15	0.8	28.000	47.909	32.478	63.340	40	20	55	34.804	1.532	0.491	2.254	0.953
360	0.2	0	0.8	72.000	138.636	89.404	187.869	100	50	200	111.041	0.818	0.491	-0.587	0.953
135	0.3	-18	0.7	27.900	44.182	32.104	56.260	40	20	50	27.241	1.220	0.491	2.137	0.953
160	0.3	-1	0.7	47.300	80.909	57.834	103.984	70	40	115	52.044	0.804	0.491	-0.342	0.953
180	0.3	-1	0.7	53.300	62.915	52.548	73.281	58	45	88	32.414	0.684	0.374	0.747	0.733
240	0.3	-5	0.7	68.500	112.182	78.244	146.120	80	50	165	76.544	0.684	0.491	-0.106	0.953
180	0.35	-5	0.65	59.750	62.875	51.571	74.179	53	40	97	35.347	0.296	0.374	-0.964	0.733
100	0.4	-20	0.6	28.000	61.364	53.468	69.259	60	50	75	17.807	0.046	0.491	0.505	0.953
120	0.4	-5	0.6	45.000	67.455	53.446	81.463	60	40	85	31.595	0.263	0.491	-0.825	0.953
120	0.4	-5	0.6	45.000	71.955	57.182	86.727	70	50	95	33.317	0.064	0.491	0.665	0.953

180	0.4	-10	0.6	66.000	59.150	48.247	70.053	65	28	80	34.091	0.002	0.374	-0.868	0.733
150	0.45	-1	0.55	66.950	77.200	67.368	87.032	75	60	100	30.743	-0.201	0.374	0.064	0.733
170	0.45	-3	0.55	74.850	66.825	56.050	77.600	65	40	100	33.692	0.143	0.374	-0.545	0.733
50	0.5	-20	0.5	15.000	28.636	21.709	35.564	25	20	35	15.625	0.779	0.491	1.139	0.953
80	0.5	-24	0.5	28.000	46.636	35.830	57.443	45	30	53	24.373	0.504	0.491	-0.336	0.953
67	0.6	-30	0.4	28.200	37.273	29.091	45.454	40	20	50	18.453	-0.008	0.491	-0.637	0.953
70	0.7	-12	0.3	45.400	47.864	39.543	56.185	50	30	60	18.768	-0.438	0.491	-0.468	0.953
45	0.75	5	0.25	35.000	32.850	28.198	37.502	35	25	40	14.545	0.032	0.374	0.276	0.733
50	0.75	10	0.25	40.000	40.550	35.154	45.946	40	32	50	16.872	0.144	0.374	0.184	0.733
50	0.8	-50	0.2	30.000	37.909	29.480	46.338	40	16	50	19.011	-0.297	0.491	0.253	0.953
55	0.8	5	0.2	45.000	41.700	36.391	47.009	43	30	50	16.601	-0.099	0.374	-0.207	0.733
60	0.8	-5	0.2	47.000	51.727	45.337	58.118	50	45	58	14.413	-0.175	0.491	1.628	0.953
90	0.8	-10	0.2	70.000	68.227	54.079	82.376	70	50	85	31.911	-0.013	0.491	1.390	0.953
35	0.85	0	0.15	29.750	30.425	25.453	35.398	30	20	35	15.548	2.210	0.374	8.741	0.733
28	0.9	-100	0.1	15.200	20.818	11.705	29.931	25	5	26	20.553	2.785	0.491	10.727	0.953
50	0.9	25	0.1	47.500	39.295	35.118	43.472	40	30	50	13.059	-0.581	0.374	-0.333	0.733
55	0.9	-30	0.1	46.500	36.955	28.513	45.396	30	19	50	19.040	0.854	0.491	1.238	0.953
80	0.9	-15	0.1	70.500	70.500	62.329	78.671	72	63	78	18.428	-0.954	0.491	3.727	0.953

H	p	L	1-p	EV	Mean	-95%	95%	Median	Lower Quartile	Upper Quartile	Standard deviation	Skewness	Std.Error Skewness	Kurtosis	Std Error Kurtosis
buying prices															
250	0.1	-10	0.9	16.000	20.198	11.775	28.621	10	8	30	17.475	1.200	0.524	0.207	1.014
125	0.2	-12	0.8	15.400	25.969	16.007	35.931	18	10	45	20.668	0.768	0.524	-0.491	1.014
200	0.2	-15	0.8	28.000	36.824	24.329	49.318	40	15	50	25.924	0.960	0.524	0.975	1.014
360	0.2	0	0.8	72.000	50.279	37.099	63.459	50	30	70	27.345	0.271	0.524	-0.470	1.014
135	0.3	-18	0.7	27.900	36.130	25.020	47.240	30	15	50	23.051	0.621	0.524	0.193	1.014
160	0.3	-1	0.7	47.300	43.678	32.517	54.839	40	23	60	23.157	0.463	0.524	-0.456	1.014
180	0.3	-1	0.7	53.300	39.300	16.461	62.139	28	10	62	31.927	0.739	0.687	-0.557	1.334
240	0.3	-5	0.7	68.500	55.375	43.090	67.659	60	28	70	25.487	-0.044	0.524	-0.365	1.014
180	0.35	-5	0.65	59.750	60.700	21.479	99.921	30	20	79	54.827	1.419	0.687	1.164	1.334
100	0.4	-20	0.6	28.000	35.096	26.656	43.536	40	20	40	17.512	0.709	0.524	0.940	1.014
120	0.4	-5	0.6	45.000	36.774	28.386	45.162	38	20	50	17.402	-0.003	0.524	-1.189	1.014
120	0.4	-5	0.6	45.000	44.762	35.843	53.680	50	30	60	18.504	-0.258	0.524	-0.839	1.014

180	0.4	-10	0.6	66.000	34.300	22.834	45.766	37	15	45	16.028	0.097	0.687	-1.507	1.334
150	0.45	-1	0.55	66.950	59.500	36.354	82.647	45	35	65	32.357	1.453	0.687	1.428	1.334
170	0.45	-3	0.55	74.850	55.800	21.711	89.889	40	15	84	47.653	0.880	0.687	-0.042	1.334
50	0.5	-20	0.5	15.000	20.613	15.542	25.684	20	15	25	10.521	1.270	0.524	2.421	1.014
80	0.5	-24	0.5	28.000	32.062	23.250	40.874	30	18	40	18.283	0.891	0.524	1.416	1.014
67	0.6	-30	0.4	28.200	27.381	21.035	33.727	30	20	30	13.166	1.339	0.524	3.928	1.014
70	0.7	-12	0.3	45.400	36.960	29.062	44.858	32	25	40	16.386	0.806	0.524	0.177	1.014
45	0.75	5	0.25	35.000	39.700	19.767	59.633	31	15	43	27.865	1.376	0.687	1.464	1.334
50	0.75	10	0.25	40.000	36.800	19.953	53.647	30	25	30	23.550	2.603	0.687	7.096	1.334
50	0.8	-50	0.2	30.000	28.845	22.599	35.091	25	20	40	12.958	0.715	0.524	-0.063	1.014
55	0.8	5	0.2	45.000	46.900	31.038	62.762	45	25	53	22.173	1.508	0.687	3.551	1.334
60	0.8	-5	0.2	47.000	35.294	26.996	43.592	30	23	50	17.217	0.208	0.524	-0.323	1.014
90	0.8	-10	0.2	70.000	47.161	37.931	56.391	49	35	60	19.149	0.305	0.524	-0.077	1.014
35	0.85	0	0.15	29.750	31.500	17.089	45.911	28	15	30	20.145	1.765	0.687	3.557	1.334
28	0.9	-100	0.1	15.200	19.053	13.230	24.875	20	8	20	12.081	0.850	0.524	0.089	1.014
50	0.9	25	0.1	47.500	38.800	21.540	56.060	34	25	40	24.128	1.979	0.687	5.202	1.334
55	0.9	-30	0.1	46.500	31.560	24.393	38.728	30	20	45	14.871	-0.060	0.524	-1.021	1.014
80	0.9	-15	0.1	70.500	50.947	42.799	59.096	50	30	60	16.907	0.022	0.524	-1.124	1.014